Increasing the use of DG in the Semiconductor industry

Distributed Power and Industrial DG
Program Review/Peer Review
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INTERNATIONAL SEMATECH

intel

- **Technical Project Manager,**
  Tom Rizy, ORNL

- **Project Manager,**
  Barry Cummings, SRP

Strategic Plan for Distributed Energy Resources *

"Document and widely disseminate the findings of the energy, economic, and environmental benefits of the expanded use of distributed energy resources"

[of combined DER benefits to large energy users, energy suppliers and energy delivery systems]

*Office of Energy Efficiency and Renewable Energy DOE, eptember 2000

Comprehensive National Energy Strategy(CNES)

- Improve efficiency of energy system
- Ensure against energy disruptions
- Promote energy production and use respecting health & environmental values
- Expand future energy choices

DISTRIBUTED ENERGY RESOURCES

INDUSTRIAL DISTRIBUTED GENERATION

Project status related to CNES goals

- Opportunities limited to new FABs.
- Public Process Manageable.
- Unlikely a ‘major source’ issue
- Inspections and existing review processes will be challenge.
- Requires grid connected DER

DISTRIBUTED ENERGY RESOURCES

INDUSTRIAL DISTRIBUTED GENERATION

Increasing DER Opportunities

- Combining supplier & semiconductor FAB plant benefits
- Technical and economic changes in the next 5 to 10 years

Objectives

- A management decision guideline
- Research tool for site-specific, feasibility studies
- Identified technical and economic improvements needed

DISTRIBUTED ENERGY RESOURCES

INDUSTRIAL DISTRIBUTED GENERATION

SCOPE & LIMITATIONS

- Ownership of DER not in scope
- Contractual and rate issues not in scope:

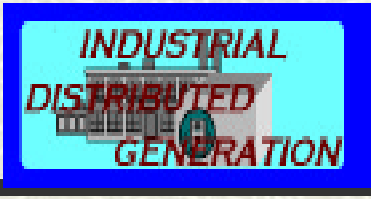
"Social Economics of Alternatives"

Or

"Is there enough $'s on the table to bother negotiating?"

Semiconductor wafer fabrication characteristics

- Energy-intensive process
- Requires stable electrical power
- Large production losses from poor power quality
- Large production losses from power outages



KEY FAB OWNER NEEDS

- No additional fuel/energy price risk
- Internal rate of return>18%
- Allow 100% factory function with any/all of the DG system shut down
- Installation not impact factory start-up schedule
- Factory reliability improved

DISTRIBUTED ENERGY RESOURCES

INDUSTRIAL DISTRIBUTED GENERATION

DER Supplier's needs

- Economical compared to other generation alternatives
- DER grid and 'islanded' dispatchable by utility
- Does not require 'Major Source' air quality permit
- Highly reliable, i.e. > 98%

DISTRIBUTED ENERGY RESOURCES

INDUSTRIAL DISTRIBUTED GENERATION

Initial forecasts thru 2010

- Combustion turbines most likely DER for next 5-10 years.
- Fuel cells may become competitive.
- # DER "Retrofits" at existing FABS will be Insignificant. [economics, space, operation, external constraints]

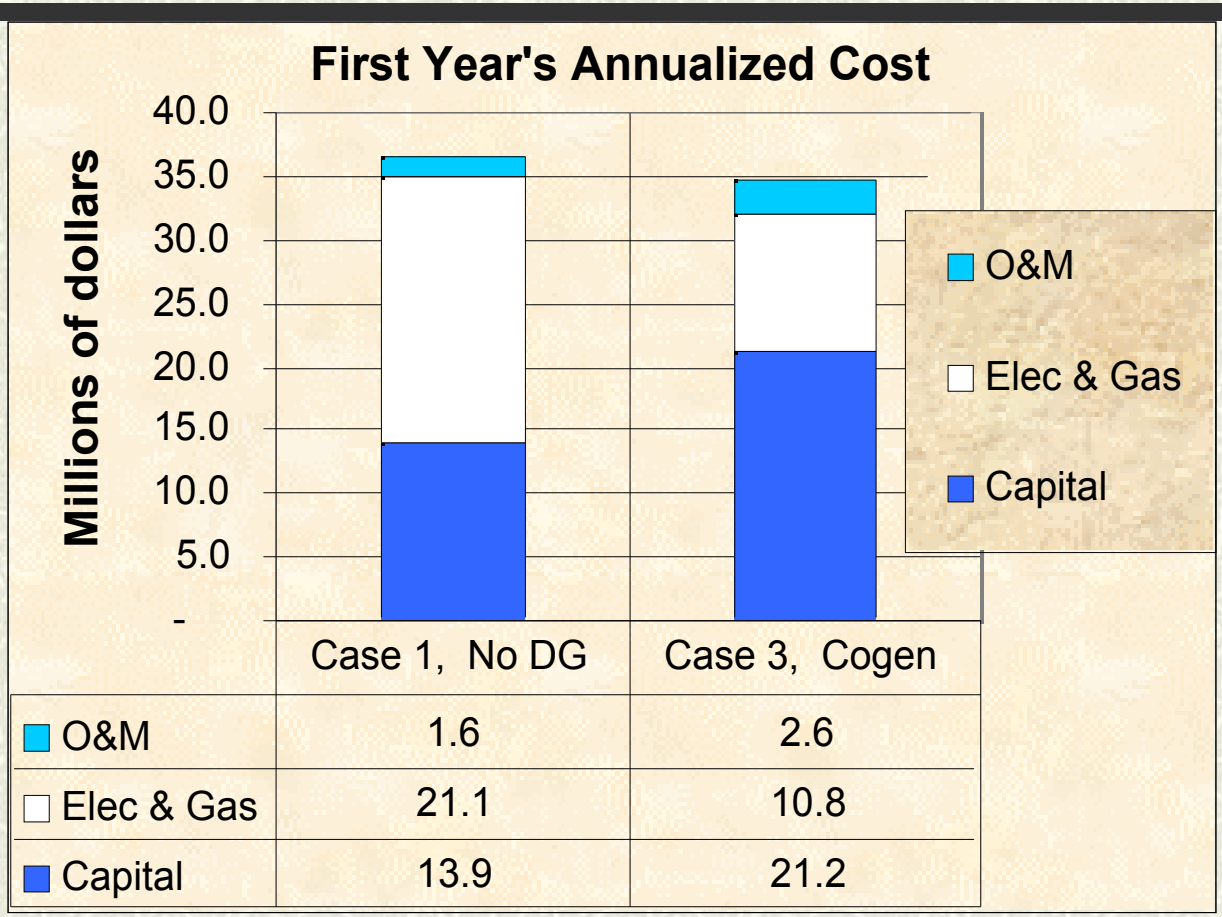
DISTRIBUTED ENERGY RESOURCES

INDUSTRIAL DISTRIBUTED GENERATION

Two alternatives: One GE LM 6000 or Two GE LM 2500

	CASE							
	2A	2B	3A	3B	4A	4B	5A	5B
1-GE LM 6000	X	X	X	X				
2-GE LM 2500					X	X	X	X
Cogeneration	X	X	X	X	X	X	X	X
Combined Cycle	X	X			X	X		
Simple Cycle			X	X			X	X
Steam Turbine Chillers	X		X		X		X	
Absorption Chillers		X		X		X		X

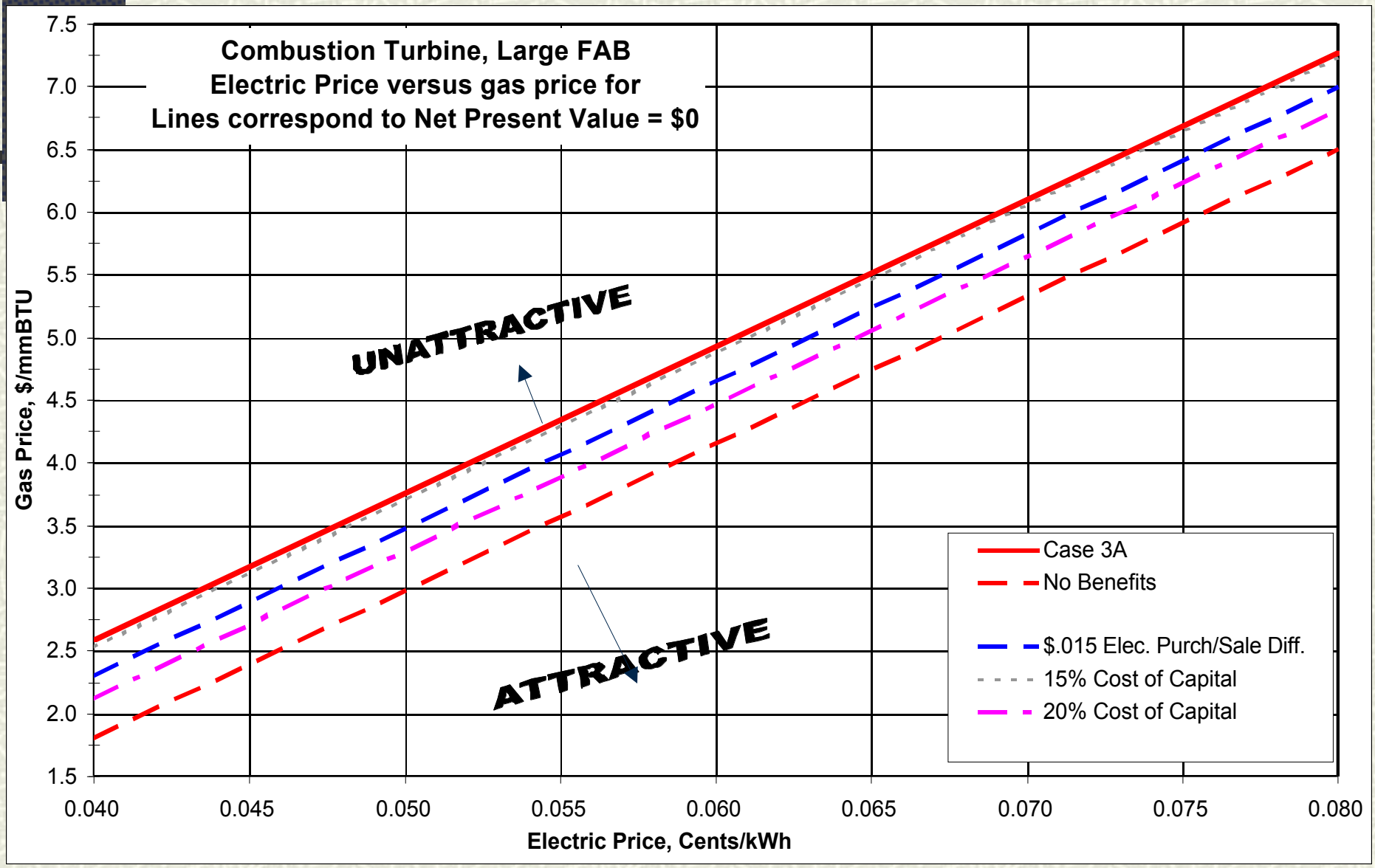
Combustion Turbine DER Annualized Cost*



	Case 1, No DG	Case 3, Cogen
O&M	1.6	2.6
Elec & Gas	21.1	10.8
Capital	13.9	21.2

- Case 3A – Cogeneration, 45 MW combustion turbine,140,000 sq ft clean Room

Key Variables Sensitivity – Combustion Turbine



- Case 3A – Cogeneration, simple cycle 45 MW combustion turbine at 140,000 sq ft

Combustion Turbine DER, ancillary benefits

OPERATIONS

- Product losses from voltage sags > $1.5M/yr
- Delivery system losses reduced >$400,000/yr

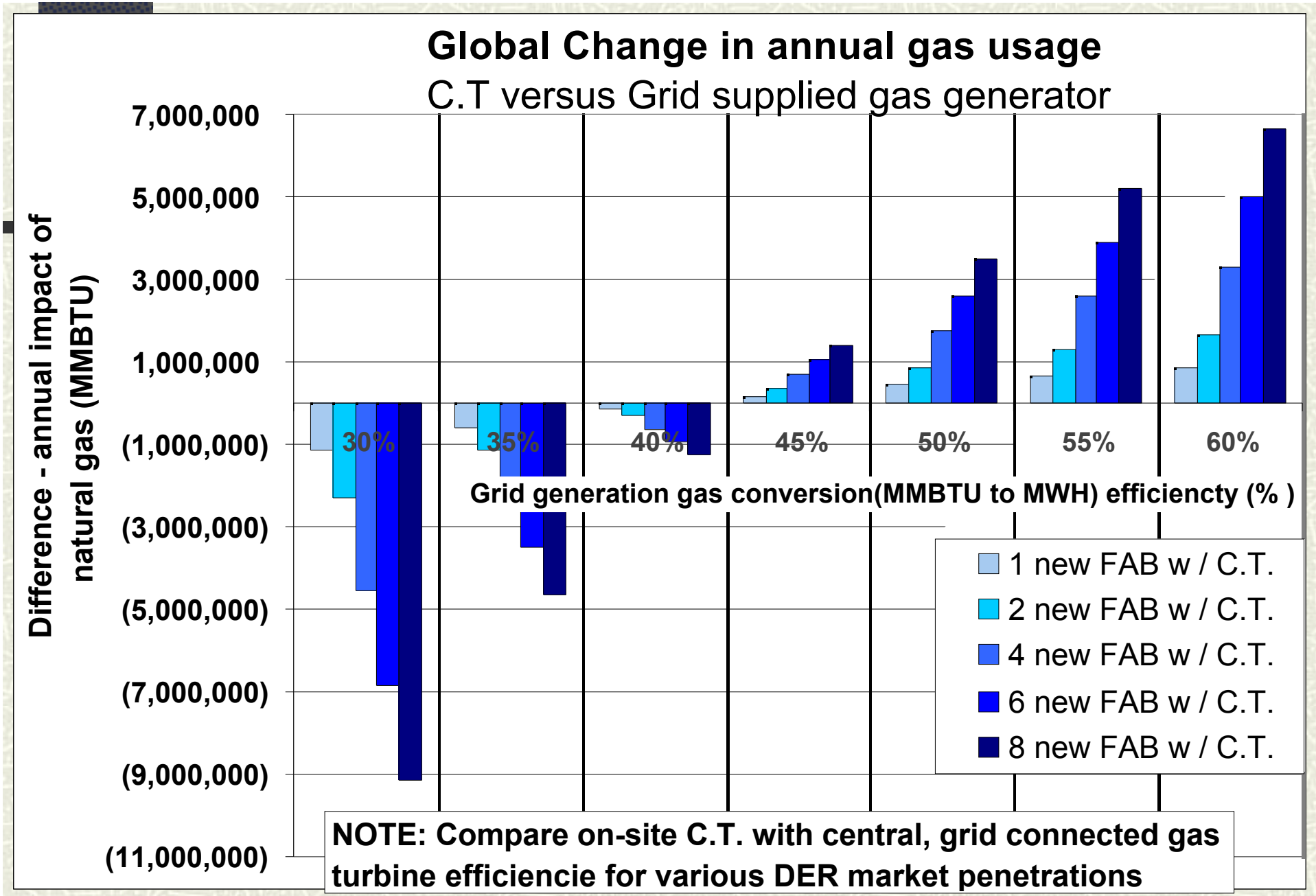
CAPITAL

- $2M for one less redundant transmission line
- $4M Reduced Diesel back-up generation

Combustion Turbine, DER Site (Case 3) Air Emissions

- NOx - 20 tons per year
- CO - 23 tons per year
- SOx - 12 tons per year
- Particulate matter* - 45 tons per year
- Volatile organic compounds - 4 tons per year

NOTE: Cogen Simple Cycle Combustion Turbine DER


Global Change in annual gas usage
C.T versus Grid supplied gas generator
Difference - annual impact of natural gas (MMBTU)
7,000,000
5,000,000
3,000,000
1,000,000
(1,000,000)
(3,000,000)
(5,000,000)
(7,000,000)
(9,000,000)
(11,000,000)
30%
35%
40%
45%
50%
55%
60%
Grid generation gas conversion(MMBTU to MWH) efficiencty (%)
1 new FAB w / C.T.
2 new FAB w / C.T.
4 new FAB w / C.T.
6 new FAB w / C.T.
8 new FAB w / C.T.
NOTE: Compare on-site C.T. with central, grid connected gas turbine efficiencie for various DER market penetrations

END

The following are Back-Up Slides to respond to questions

Status

Develop DG Guidelines - Complete

Develop Design Concepts - Complete

Determine Potential Markets - 01/02

Identify Key Risk Factors - 01/02

Draft Final Report - 01/02

Review Final Report – 03/02

Alternatives within contract scope

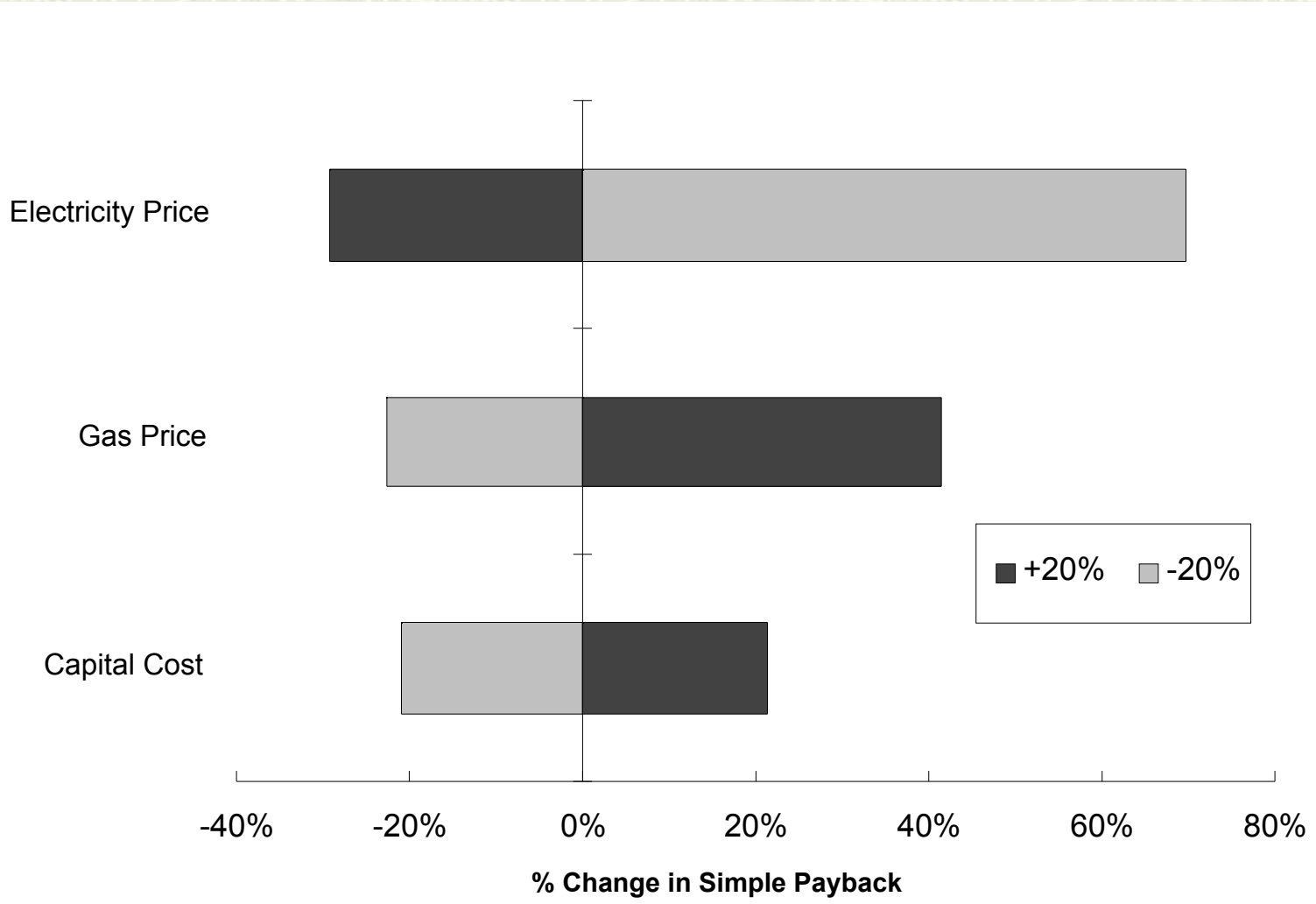
- Gas Turbines
- Fuel Cells
- Alternative energy sources requiring energy storage

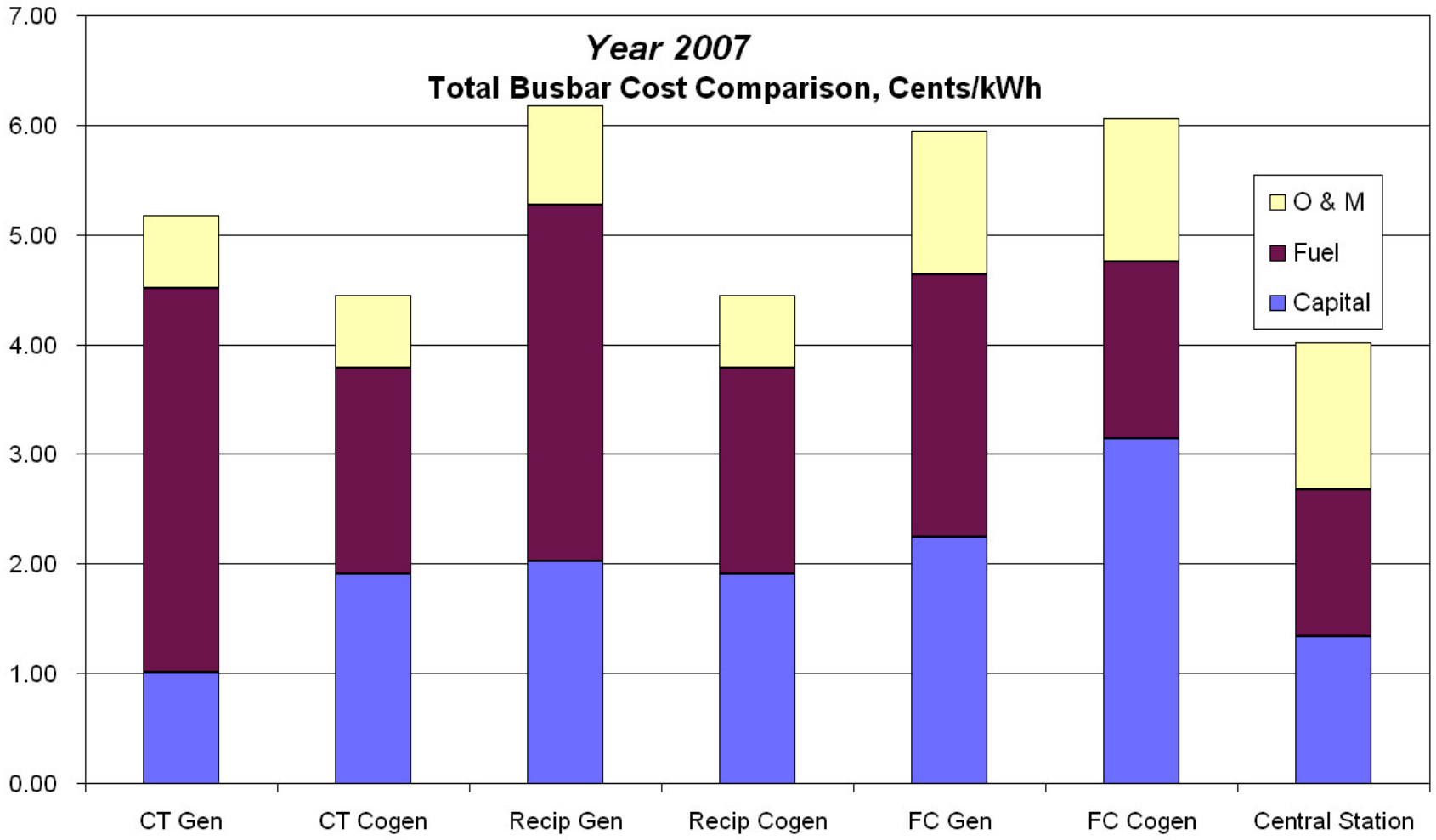
Conceptual Design Scope

DER engineering feasibility design addressing;

- Economics,
- Infrastructure,
- Energy delivery,
- Institutional,
- Regulatory needs.

Sensitivity for key elements



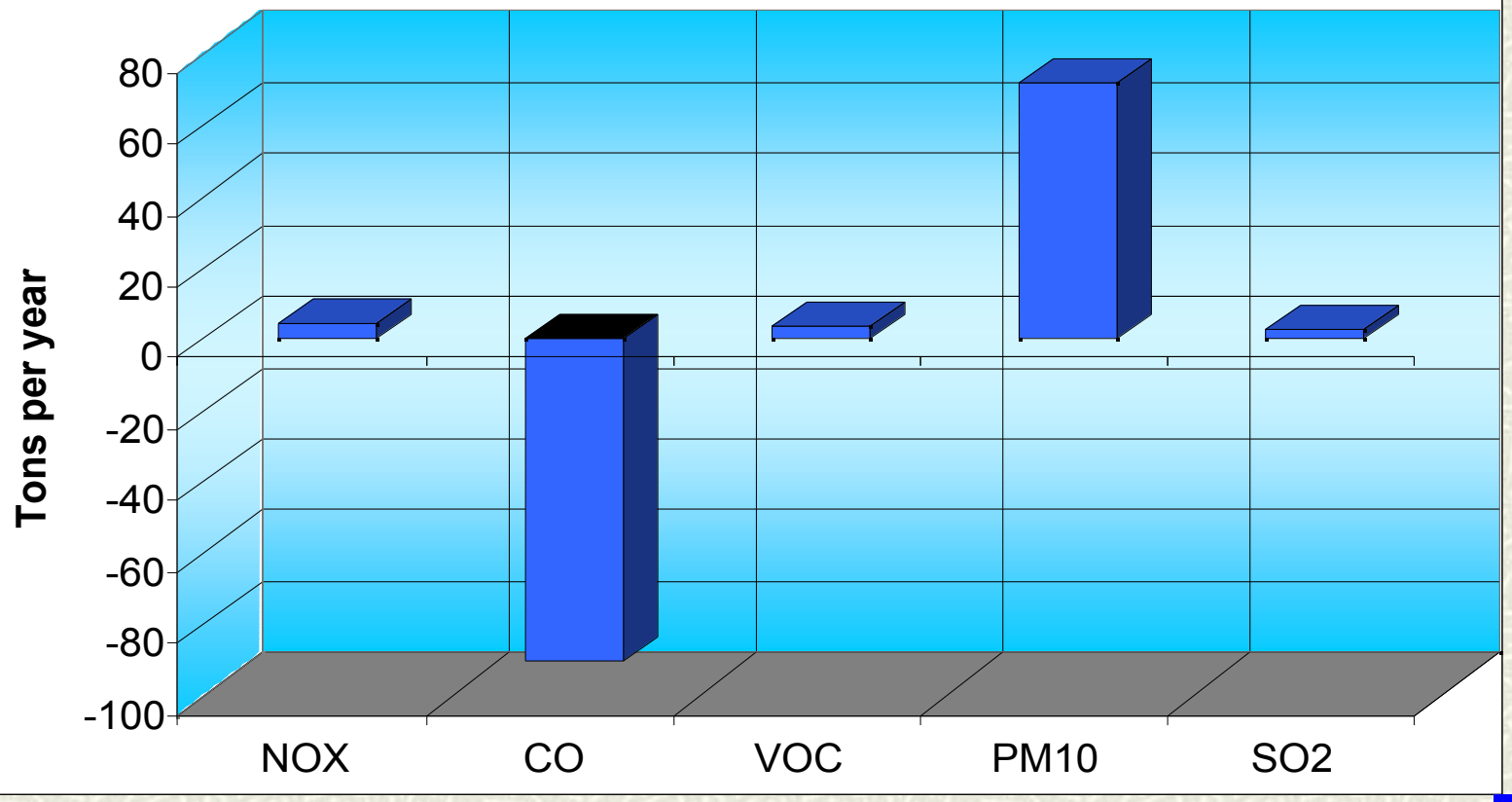

Year 2007
Total Busbar Cost Comparison, Cents/kWh
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
O & M
Fuel
Capital
CT Gen
CT Cogen
Recip Gen
Recip Cogen
FC Gen
FC Cogen
Central Station

DG comparison

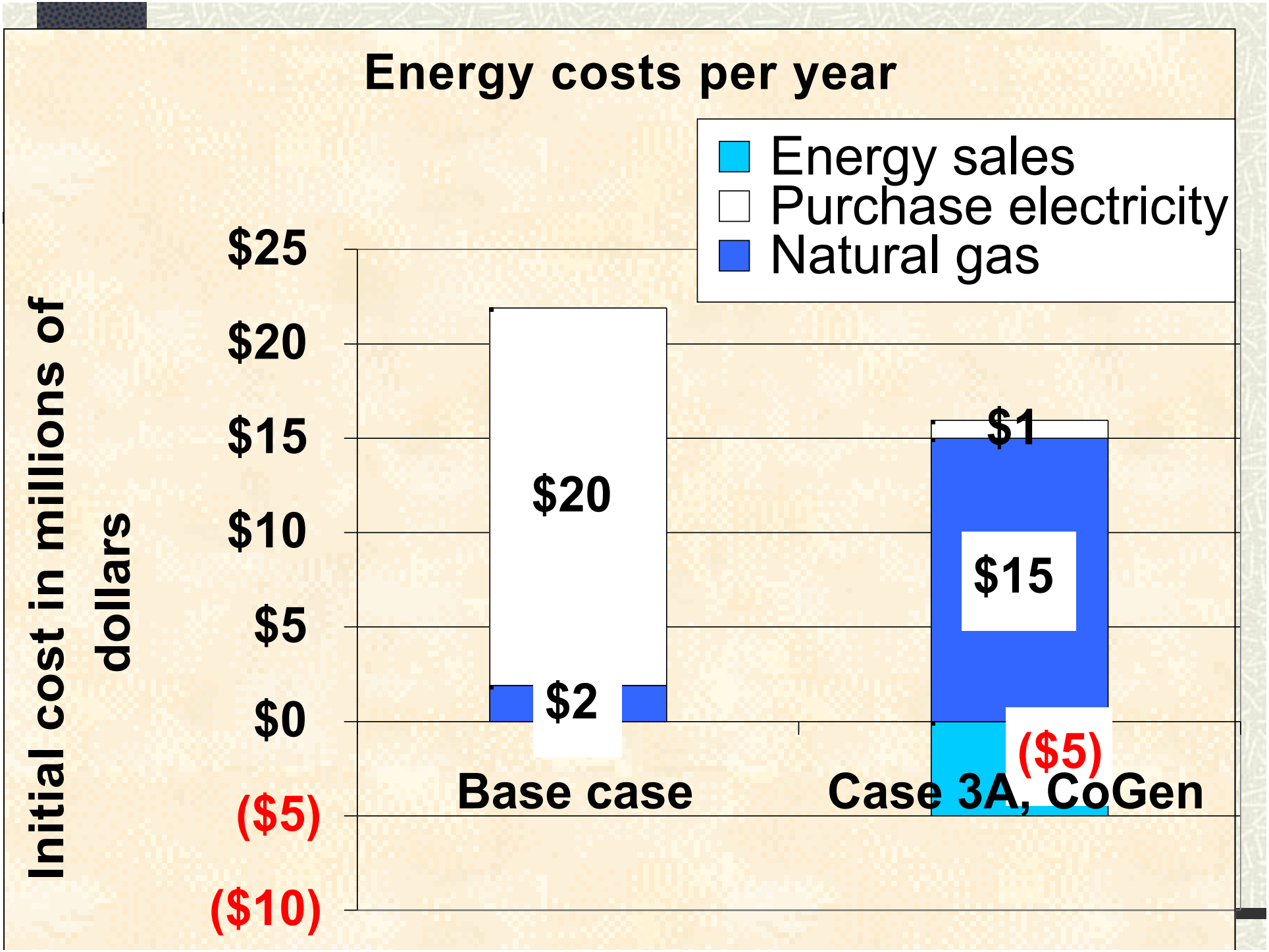
	Combustion Turbines (w/o cogen)	Fuel Cells	Solar PV	Grid combined cycle
Plant Capital Cost, $/kW	450	4,000	6,500	600
Fixed O&M, $/kW-yr	20	91.4	17	6
Net Heat Rate, BTU/kWh HHV	10,500	7,500	n/a	7,300
First Year's Cost, Dollars/MWh	54	138	500	51

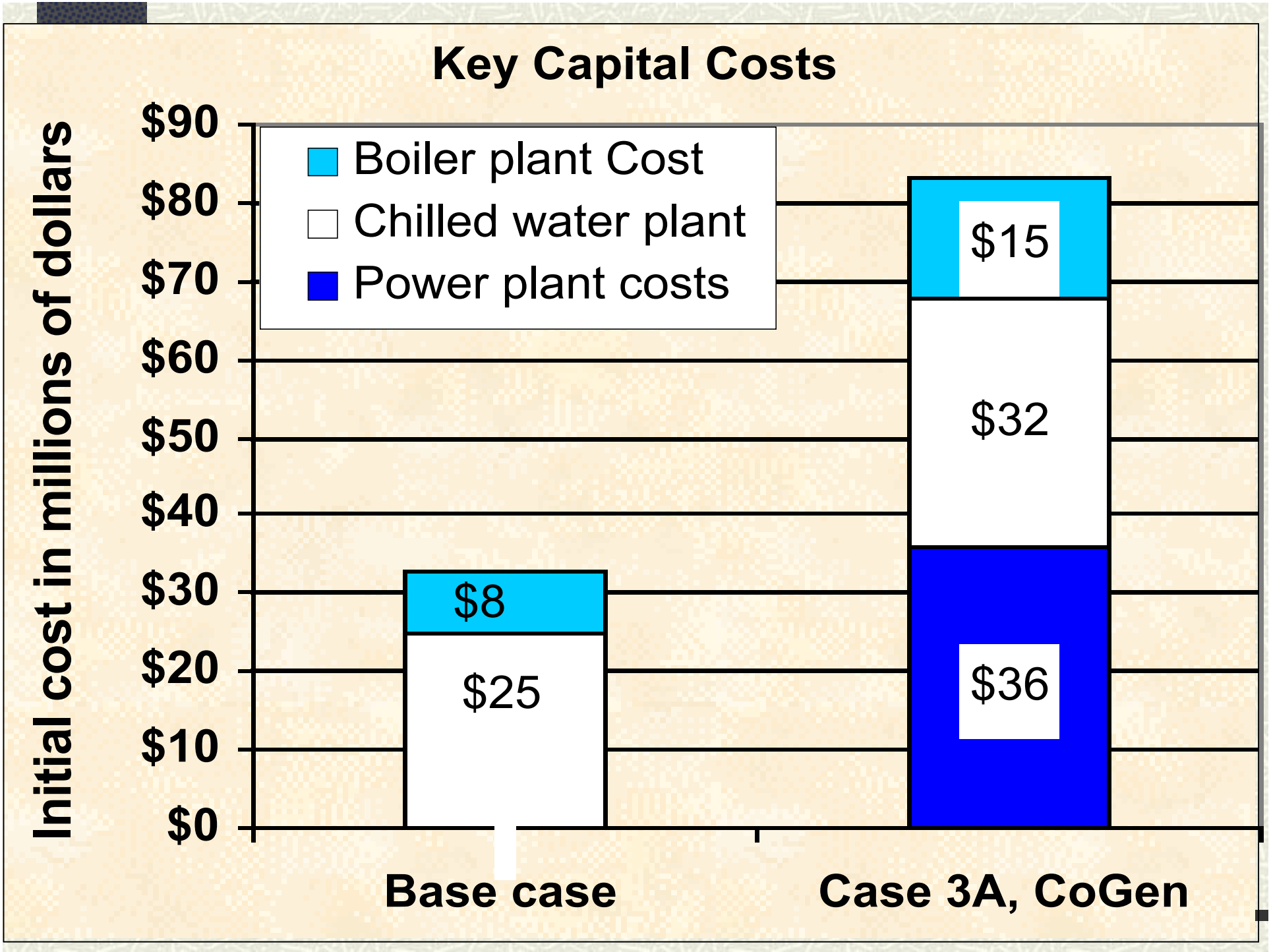
1 year total tons of emission change, at site, DG versus no DG 100% 35k clean room new plants

(average seven 2002 & 2003 planned new fabs)



INDUSTRIAL DISTRIBUTED GENERATION


Energy costs per year
Energy sales
Purchase electricity
Natural gas
Initial cost in millions of dollars
$25
$20
$15
$10
$5
$0
($5)
($10)
$20
$2
$1
$15
($5)
Base case
Case 3A, CoGen


Key Capital Costs
Initial cost in millions of dollars
$90
$80
$70
$60
$50
$40
$30
$20
$10
$0
Boiler plant Cost
Chilled water plant
Power plant costs
$8
$25
$15
$32
$36
Base case
Case 3A, CoGen